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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G06F 17/60	A1	(11) International Publication Number: WO 98/11493
		(43) International Publication Date: 19 March 1998 (19.03.98)

(21) International Application Number: PCT/NZ97/00115

(22) International Filing Date: 10 September 1997 (10.09.97)

(30) Priority Data:
299334 10 September 1996 (10.09.96) NZ

(71) Applicant *(for all designated States except US)*: TRUCOST MANAGEMENT LTD. [NZ/NZ]; 131a Armagh Street, Christchurch (NZ).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: KENTON, Branton [GB/NZ]; 2/400 Manchester Street, Christchurch (NZ).

(74) Agent: LEWIS, Mardi, Joan; Lewis & Associates, P.O. Box 2201, Christchurch 8015 (NZ).

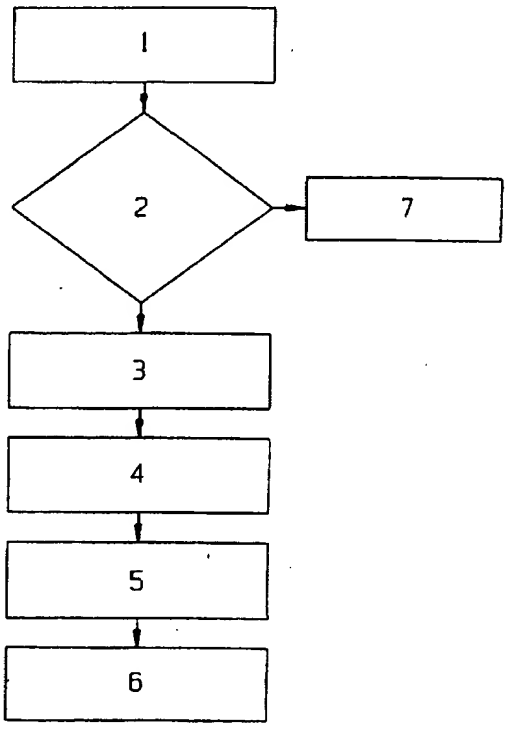
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: METHOD AND MEANS FOR CALCULATION OF ECOLOGICAL COST OF PRODUCTS

(57) Abstract

A computer controlled process is provided for quantifying the consumption of ecological capital in producing any predetermined product. The consumption of ecological capital is determined by whether or not the substances used in the manufacturing of that product satisfies three (or four) conditions of ecological sustainability (2) in respect of the production and use of that product. Ecological sustainability is determined by the satisfaction of three or four predetermined conditions which apply to the manufacture and use of all products. The process is computer controlled by an algorithm which ascertains the physical substances used (10) and incorporates the conditions of ecological sustainability (2, 3, 4). Additional steps (5, 6) permit the quantification of the ecological cost of the consumption of ecological capital. The process and the two associated databases of information are able to be stored and used in a distributed electronic manner with remote accessing of the second data base for the quantification of ecological cost.



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TITLE: METHOD AND MEANS FOR CALCULATION OF ECOLOGICAL COST OF PRODUCTS

Field of the Invention

The present invention relates to a method for commercial quantification of the ecological capital cost consumed by commercial activity in the methods and production of material products. More particularly the present invention relates to a method of assessment of a financial cost for any product based on the cost of the restoration of the ecological capital that was consumed in the making of that product.

Background of the Invention

The consumption of ecological capital can be a cost to a business but at present there are few accurate methods or processes by which such a cost can be quantified. Little has been done on the evaluation of financial savings made to a commercial operation through the effective use of ecological capital or product design aimed to reduce use of ecological capital. Nevertheless, such factors are requiring an increasingly necessary amount of time, requiring an objective basis of comparison between ecological capital consumed through the production of products and actual direct financial costs to companies, thus enabling them to increase their market by demonstrating an ecological responsibility for their products by comparing them with their competitors. Also there has been little done on developing an objective basis or standard for the analysis of the cost of restoration of the environment. Environmental impact reports are generally prepared on an individual basis with the boundaries being arbitrarily drawn for each report. This makes the comparative use of such reports limited.

Other approaches to the calculation of environmental impact in production fail because the complex interaction between physical substances in the ecosystem is insufficiently understood and insufficiently determinable.

An object of the present invention is to avoid this complexity, by using a different methodology in the quantification of consumption of ecological capital, as opposed to an analysis of the environmental impact of a product.

A further object of the present invention is the provision of a method of identifying, given the conditions on earth that are required for ecological sustainability, the cost of restoring ecological sustainability and deriving an ecological cost, for any given product.

A further object of the present invention is the provision of means for the storage of data necessary for the calculation of the consumption of ecological capital and the ecological cost for any given product. A still further object of the present invention is the provision of a method which can calculate the amount of ecological capital consumed and the ecological cost for any given product quickly and "on demand".

Ecological sustainability may be determined by the satisfaction of three system conditions. These are:

firstly, that substances from the earth's crust must not systematically increase in the ecosphere ("condition one");

secondly, that substances produced by society must not systematically increase in the ecosphere ("condition two"); and

thirdly, that the physical basis for the productivity and diversity of nature must not be systematically diminished ("condition three").

For the purposes of this specification, "ecological cost" is defined as the cost, in respect of any one product, of restoring the ecology and of satisfying the three conditions of ecological sustainability in respect of the production of that product. The "ecological capital" of a product is defined in terms of the materials used in making a product and the quantities of materials used that violate the three system conditions of ecological sustainability. The "financial cost" of the ecological capital is the cost of the materials that consume ecological capital in the production of the product.

Optionally, an additional, fourth condition of ecological sustainability may also be added, namely that fair and efficient use of resources must be made with respect to meeting human needs.

For the purposes of this specification the time taken in the manufacture of products is taken to be zero.

Summary of the Invention

The present invention provides a computer controlled process for the determination of the amount of ecological capital consumed in producing a product, said method, in respect of any one product, including:

(a) providing one or more first data bases of information including categories of information, each of which includes data on at least one product as follows:

data pertaining to determining the physical substances used in the

manufacture of said one product;

data on said physical substances and their properties (said properties including a chemical analysis) used in the manufacture of said one product;

data on all physical substances discharged in the manufacture of each product, wherein:

said substances include energy expressed as the physical substances taken to generate the energy;

data pertaining to the plurality of physical substances (including energy) used in the distribution of said product; and wherein

each said first data base is stored in memory means in an electronic medium;

(b) providing an algorithm to perform the following operations, said algorithm including three system conditions:

(i) that substances from the earth's crust must not systematically increase in the ecosphere ("condition one");

(ii) that substances produced by society must not systematically increase in the ecosphere ("condition two"); and

(iii) that the physical basis for the productivity and diversity of nature must not be systematically diminished ("condition three"); and

(c) providing appropriate programming instructions, in accordance with the algorithm, for the computer to carry out the steps of:

(i) in respect of said product, successively assessing each input physical substance used in the manufacture of said product against each system condition one and three;

(ii) in respect of said product, successively assessing each output physical substance used in the manufacture of said product against system condition two;

(iii) in respect of said product, successively assessing each physical substance used in the distribution of said product against the system conditions one, two and three, in the same manner as above; wherein

the sum of the successive assessments results in a quantitative value for the ecological capital consumed in respect of the production of said one product; whereby said instructions and algorithm are operated in a processing means connected to the or each memory means; and

(d) said value (for the ecological capital) is provided through one or more outlet media.

Optionally, data on more than one product may be stored in one said first data base. Optionally also more than one said first data base includes data on the same product. Further, each said first data base may be stored electronically in a distributed manner and accessed remotely by a user.

The above process further includes a computer controlled process for the determination of the ecological cost of restoration of the environment in respect of each product, said steps being:

evaluating the amount of ecological capital consumed, as defined above, and including the additional steps of:

under step (a) incorporating into a second data base data pertaining to the restoration cost of each said input physical substance; and

under step (c) adding the following two steps:

(iv) for each of the above assessments in which the system condition is not met, determining the quantity of each input physical substance present in said product and then successively calculating a cost for the restoration of that physical substance within the ecosystem, to the point where the system condition in question is then met;

(v) for said input product ascertaining the quantity of the product required and summing up the restoration cost for each substance for which a restoration cost is calculated, to produce a cost value for the ecological cost of the said product; wherein

said second data base is accessible remotely by users of each said first data base.

Preferably, the second data base, which is stored in an electronic medium, is accessed remotely by all users of each first data base. Preferably also, the second data base is in a form that allows for constant updating by a plurality of users so that the costings and information stored therein is as accurate as possible.

Brief Description of the Drawing

By way of example only, a preferred embodiment of the present invention is described in detail with reference to the accompanying drawings, in which:-

Fig. 1 is a diagrammatic representation of a flow chart demonstrating the operation of the algorithm in respect of assessment of the ecological cost of consumption of ecological capital in respect of the production of 1 kg of iron.

Detailed Description of the Invention

Example 1

A example of the preferred embodiment of the present invention is the example of the manufacture of soap from coal. The properties of the chemical substances in the coal (or the particular coal in question) are ascertained if they are not already available in a first data base. These substances are then entered into a first data base if not already present. All other physical substances used in the manufacture of the soap are ascertained and entered into the first data base if not already listed. The type and physical substance(s) used to release the energy used is also entered into the first data base.

If so desired, the chemicals or substances can be listed in a plurality of alternative ways, so that any one substance can be located and identified either under its common name, correct chemical name, any standard trade mark, by the makeup of elements in the substance, etc.

The manner in which energy is categorised is via an analysis of the physical substances used in the generation of the energy and quantified, for example in tonnes of coal.

Additionally, the first data base also includes the physical substances used in the distribution of the manufactured product - for example the fuel used in the physical distribution of the soap.

Optionally the second data base includes actual cost effective examples of actual ecological restoration of some or all of the physical substances in coal, depending on the availability of such information. If so desired, the restorative cost is determined by evaluating the medium value of the five most cost effective examples of ecological restoration as undertaken by ecological management organisations from whom data is available within the data base. However, other cost methods may be used.

The ecological cost of the soap is derived from the combined sum of the ecological cost of all the separate physical substances each separately assessed against the above defined three system conditions.

The algorithm is based on the equation:

$$E = N(SC1(Q*PI*\$R) + N*SC2(Q*P\ O\ *\$R) + SC3(Q*PI*\$R))$$

in which:

E = Ecological cost of product

SC = assessment against a system condition (either 0 or 1)

Q = the quantity of the input physical substance

PI = the input physical substance

P O = the physical output substance

$R = restoration cost of actual examples (or medium of five)

N = number of physical substances, either inputs, outputs or distribution values for the product respectively.

By successive summation for each of the physical substances where the various system conditions (as defined above) are not met, the ecological cost of the use of coal in the manufacture of soap is arrived at. Thus a total cost for the first use of the soap can be determined by adding the ecological cost to the market price of coal.

The method of determining the ecological capital consumed in the manufacture of a product, or additionally the ecological cost of a product, requires a means for processing the algorithm (as described below) for the quantification of the ecological capital consumed and of the ecological cost, in addition to storage means for the first and second data bases, and an input means (e.g. keyboard) and output means (e.g. VDU screen and printer). The use of computer software on appropriate computer hardware fulfils this requirement. In practice it has been found that Windows 97 (TM, Microsoft Corporation) and compatible products provided appropriate software for the operation of the invention. The appropriate hardware is any computer capable of running such software and of electronic connection to other remote) terminals (for example via the internet).

Example 2

Referring to Fig. 1 a diagrammatic flow chart of the present invention is thereshown, with reference to the production of ten kg of iron. Each box represents one step in the process. In the first step 10 a list of all the physical substances (including energy) used in the product of iron is compiled. Quantities and chemical formula are also compiled. If the data base on which the algorithm is operating does not have all the information, other remote first data bases may be accessed to obtain the information.

The second step 2 is to ascertain, in respect of each physical substance, whether this substance has consumed any ecological capital. This is assessed against each of three or four system conditions (as set out above). If none of the system conditions are violated, then no ecological capital has been consumed (7). If the answer is yes, the next step (3) is to compile a listing of the physical substance(s), the system condition violated and the quantity of each substance. Step 4 allocates an operating cost from a first data base to the consumption of this ecological capital. Step 5 involves the accessing of the second data base to obtain the restoration cost for the ecological capital consumed by the physical substance for the quantity of that substance.

Referring to the production of ten kg of iron: the system conditions which are violated are condition one (that substances from the earth's crust must not systematically increase in the ecosphere) as well as condition two and condition three in respect of the man made chemicals used in the smelting process and the land upon which the smelter is built (respectively). The financial cost of the production of ten kg of iron is (for example) $69. However the ecological cost (restoration so that none of the system conditions are violated) is $178. These two figures are compared in the final output (6).

Example 3

It is to be noted that the products for which this cost analysis is conducted need not be derived de novo from substances au naturel in the earth's ecosphere. For example, prevention of systematic accumulation of facsimile machines in the ecosphere (and thus fulfilling the first system condition in respect of this product) may be for a commercial force to initiate a buyback scheme and recycle or sell the machines or all the parts. Such action (provided no processing or manufacture/distribution was incurred in the recycling process) would fulfill all three (and the optional fourth) system conditions. Thus the ecological cost of reselling facsimile machines would be zero.

Thus any complete recycling of a product, without any material, distribution or energy input would have a zero ecological cost.

If so desired, the second data base containing the information on restoration costs and of each physical substance is a data base which is stored electronically, but accessed remotely by all users of the or each first data base. With appropriate programming security, the data contained in the second data base could be constantly updated by the relevant organisation (who originally contributed the data) without the

base being unavailable to other users.

If so desired, with appropriate software and computer hardware, accessing the data base for information for ecological costings can be remote and by multiple concurrent users.

Example 4

On the following sheets is a table of various aspects of the quantification of used in the determination of the answers to the questions in step 2 of Example 2 (above).

Table 1

Description	Level	Reason	Example	Question
SC1 assessed on inputs	SC1 rule	Any physical substances will be extracted from the lithosphere before their use	Iron from the lithosphere used to make car mirrors is calculated by the amount at the time of input into the value chain.	Does this physical substance imputed or its component parts violate SC1?
Lithospheric PS's are only assessed for SC1 in the Origin PM	SC1 rule			
The system defaults that elements present in the lithosphere are from the lithosphere	SC1 rule	The system defaults in favour of the earth		
Components of lithospheric substances must be entered if there are any	SC1 rule	The restoration price of Lithospheric substances is based on their compound components.	Calcium, Carbon and Oxygen are the components of Limestone ($CaCO_3$)	Any there any components to this lithospheric PS?
SC1 assessment requires that all composite Lithospheric PS have their components entered through various levels of detail until the compounds are arrived at	SC1 rule	The system can only discern what are the components if they are listed	The restoration cost of Coal is the cost of restoring the Carbon, Sulphur and other components that constitute it.	
Elements that are not derived from the lithosphere need to be tagged as "ecospheric elements"	SC1 rule	The system asses SC1 costs only on Lithospheric tagged PSs.	Gold is an element. Yet if the gold was ecosphere derived or recycled (as opposed to lithosphere derived) a new PS called "eco-gold" would need to be created in the system.	Does this element derive from the Lithosphere?

Trees are an acceptable method of restoring SC1 in relation to Carbon	SC1	Trees are a medium term carbon store. This falls short of SC1 criteria but does promote the restoration of biomass (and hopefully bio-diversity) of SC3 through the creation of market incentives to plant trees. For the overall system point of view good.	The CO_2 from fuel emissions can be calculated by the cost of planting and maintaining biomass capable of up taking the Carbon of the fuel.	Is the uptake of Carbon through sustainable forestry a cost effective method of restoring SC1?
The use of recycled PSs in a commercial stream incurs no SC1 cost. (Recycled - PSs that have already served their intended purpose - and have therefore already had their SC1 calculation made for them. Also they are already in the ecosphere therefore not contributing to systematic accumulation.)	SC1	Because there is no systematic accumulation of the physical substance in the ecosphere - it is already there.	Waste paper, scrap iron, tin cans, tyres.	Has the physical substance already been used in its intended purpose? Does the physical substance come from the lithosphere or has it been recycled from the biosphere?
The associated PS extracted at the same time and locality as a PS used in an input into the production moment have no ecological cost.	SC1 rule	Until the supply chain back to restoration is better quantified it is difficult to know what associated compounds were extracted at the same time.	A company is not responsible for the other rock and mineral extracted at the same time that the iron is has purchased for its production moment was extracted.	What associated PSs were extracted from the lithosphere at the same time as the PS used in the production moment?
SC2 violation is assessed on outputs.	SC2 rule	Synthetic materials will only accumulate after they have been produced.	Araldite may be an input into a furniture making business but it is also an output. It is its output as part of the table that violates SC2.	Does this physical substance outputted in its present physical structure violate SC2?
SC2 is assessed on the outputs of all PMs that are part of the commercial stream, including the end product.	SC2 rule	All man made compounds violate SC2, whether they continue through the commercial stream or are releases as waste products.		
SC2 assessment requires that if an output is a composite PS then its components must be entered. (These components will be derived from the outputs of previous - upstream - PMs).	SC2 rule	The system can only track the man made PS of composite PS through their components. Otherwise if does not know what they are made of.	A windscreen assembly for a car may contain a synthetic glue. This will only be know if the components of the windscreen (a composite PS) are known.	

SC2 cost of any composite PS is calculated from assessing its compound components.	SC2 rule	A composite is made up of various PSs. These PSs may themselves be composites. The system needs to go back to the compound level in order to assess for SC2 violation.	A car is a composite. A windscreen assembly of the car is also a composite. But the glue used on the windscreen is a compound. This the system can assess for SC2 violation,	
Man made PSs recycled from the ecosphere, (but not from closed technological cycles) have zero SC2 cost	SC2	If the PS has come from the ecosphere there is no systematic accumulation of the PS, hence no SC2 violation	PCBs recovered from the soil have not SC2 cost	Has this man-made physical substance derived from the ecosphere?
Ecosphere derived (recycled) man made PSs need to be created as such for the system, e.g. 'PCB's would become 'recycled PCB's and labelled as coming from the ecosphere	SC2 rule	The system will treats all man made PS as potential violations of SC2. Tagging the PS as ecosphere derived would signal a zero ecological cost	PCBs recovered from the soil are entered as recycled PCB and tagged as coming from the ecosphere	Is this man-made PS been recycled?
SC2 can be restored through: 1. Breaking the physical substance down into its naturally occurring substances, 2..recycling the physical substance in a permanent technical cycle, 3. sealing the substance in the bedrock as a final repository	SC2	All these processes prevent the systematic accumulation of the physical substance in the ecosphere	It may be possible to break down CFCs into their naturally occurring constituent parts, to recycle it in new fridges, or to seal it in the bedrock	What is the cheapest means of restoring SC2 for this physical substance?
The cost of recycling in a technological loop in order to restore SC2 must include the ecological cost of restoring in another way the percentage of the physical substance lost to the ecosphere during recycling	SC2	Responsibility for the physical substance remains until it is passed on by the manufacturer of another value chain. There is always some loss in the recycling of materials.	The plastic in a car battery could be cleaned and made ready for a new battery through a buy-back system. The cost of managing this system + cost of any batteries that are not returned and therefore cannot be recycled = restoration cost of SC2	What is the cost of preparing the physical substance for re-use + what is the cost of restoration for the physical substance lost during recycling?
Man made physical substances systematically accumulate in the ecosphere.	SC2	By definition man made substances are not usually present in the Ecosphere. The system treats them as persistent until they are proven otherwise.		Is this PS man made?
If a physical substance can be man made, then the system treats it as man made until confirmed otherwise.	SC2	The system defaults in favour of the earth		

If SC3 violation occurs through more than one product, then its cost is allocated using the depreciation model current for the user company's standard accounts	SC3	SC3 violation may take place over many commercial streams. Companies spread their capital costs through depreciation models. The same can be done to spread the cost of SC3 ecological capital	A factory is built on an area of land which violates SC3. The ecological cost of violation is spread over the depreciation lifetime of the factory, and each product as a percentage of that allocation	What is the depreciated lifetime of the locality (e.g. factory or quarry), and what percentage can be allocated to this specific product?
The assessment of SC3 violation requires that the terrestrial or aquatic area be entered as an input into a factory PM. It is input as a 'section'. It's cost is allocated in the PM in terms of the number of 'factory hours' required.	SC3 rule	The system treats all inputs as PS, including specific areas of land. To ascertain the quantity of land used it needs to be translated into 'factory hours'. This is the method to do this.	Peat is dug from a 12 ha site for the production of compost. The PS 12ha becomes an input to a Peat Factory Production Moment, whose output is 50,000 hours ie. the expected lifetime of the site.	What is the Capital PS whose input is this area?
SC3 assessment concerns the POTENTIAL of a specific terrestrial or aquatic area to revert to its climactic state and the ACTUAL diversity present in the area	SC3	Harvest of specific products from areas represent current income. It is the ability of an area to produce this harvest, as measured by productive capacity and diversity, that constitutes ecological capital	A runway at an airport covers land with Tarmac which prevents the land from reverting to its full potential. Hence it violates SC3. The farmers field next door would revert if left to its own devices and hence has no SC3 cost	Has this area retained its diversity and the potential to revert to its full and productive capacity?
Productive potential is assessed through soil quality. If the soil quality is said to be reduced by measuring various criteria then the area of land is said to have lost its productive capacity.	SC3	Soil quality is the determining local factor governing the ability of a terrestrial area to reach its productive potential	Compaction through logging has reduced the soil quality of an area. The area is said to have lost its full productive potential	Has soil quality been maintained for this area?
Terrestrial areas can be said to have comparable potentials for productive capacity by assessing their biome they would naturally support. These biomes are then classed as areas of High, Medium or Low productive potential	SC3	Biomes primarily the result of temperature and rainfall. These are also the main factors (other than soil quality and topography) governing productive capacity. Biomes are therefore an indicators of productive capacity.	The desert biome has low rainfall. It also has low productive capacity. Which	Biome does this area naturally produce?
The diversity of a terrestrial area can be assessed using Anderson Land Use Codes and classifying them into areas of High Meduim and Low diversity	SC3	The Anderson codes are widely used in GIS imagery and cover both natural and man made areas.	An area coded as 'Industrial is said to have low diversity.	Which Land Use Code is appropriate for this terrestrial area?

The diversity of an area, or comparable area is said to be restored if an area is raised to the next level of diversity.	SC3	It is not enough to replenish a specific species that has been removed because of the complex relationships involved in a ecosystem. Therefore the means to guarantee restoration of diversity is to raise the general level of diversity of an area	The diversity of an industrial site has been diminished. Its restoration involved the cost of turning an industrial site into residential housing	What is the level of diversity of this area?
Restoration of SC3 requires that the terrestrial or aquatic area is restored in the same floristic region as the area violated	SC3	Maintaining floristic regions maintains diversity at the ecosphere level	An area of land in New Zealand Floristic region can only be compared in terms of diversity with another area in the same floristic region	Which floristic region does this area of land belong to?
If an area is certified as sustainability managed under accepted management plans, it is taken that there has been no SC3 violation	SC3	Certified management plans protect productive capacity of land and species diversity	Timber harvested from FSC (Forest Stewardship Council) certified areas has no SC3 violation	Is this area from which this product has been harvested certified as sustainably managed?
Order to enter SC3 inputs to be allocated across more than one product or PM: 1.Create factory Capital PS. 2. Create terrestrial/aquatic PS 3. Create Factory PM 4. Input terrestrial/aquatic PS as section input into factory PM 5. Have Factory PS (hours) as output for Factory PM	SC3 rule	The assessment requires that the ecological capital consume by an area of land be allocated. This entails converting an area into hours	A factory stands on 3 ha of land and has a capital depreciation period of 5 years during which it produces 1000 products. Through this method the area is divided by the products	How is this area across products?
SC3 costs are allocated through translating sections into hours via rule 310. SC3 restoration costs from the database are calculated using ha/acres	SC3 rule	The restoration cost will be based on land area whereas the allocation of cost is via hours	3 acres of land may be used to build a new factory. The database contains prices to restore comparable land of a comparable size while the system allocates this restoration cost to products via a depreciation model using hours of productive use	What is the size of the land being assessed? Over what time is the land being depreciated?
SC3 violation is calculated at the most downstream PM	SC3 rule	The allocation of cost will only be known at this level	A quarry mining limestone may be 12ha in size, yet the SC3 cost allocated to this packet of chalk is a tiny fraction of the entire productive life of the quarry.	Is this the most downstream PM?

If a terrestrial or aquatic area is protected by national or international agreement then SC3 costs entail the restoration of the exact same habitat and flora/fauna species	SC3	An area is generally protected to ensure the survival of rare species or habitats. This accords with SC3 and there needs to be no further reduction in these species/habitat types	A mining operation in Arthur's Pass National Park in NZ has destroyed the productive potential of 2ha of land. SC3 costs = the cost of restoring the same flora/fauna species to land of same area currently without productive potential	Is this terrestrial or aquatic area protected?
The cost of areas or species that are protected by national or international treaty cannot be provide for.	SC3	The cost is calculated from a planetary systems point of view. It is not equipped to deal with local instances of species or habitat depletion	A mining operation in Arthur's Pass National Park, New Zealand, that removed the productive potential of land would have to input its own restorative cost for SC3 violation	What is the cost of SC3 violation of this specific locality?
SC3 costs for terrestrial or aquatic areas that have been apportioned to a product via a depreciation system are ADDED to the other ecological costs for this product in the calculation bin	SC3 rule	This cost is complete in itself. No other calculation needs to be made to it	Its takes 0.02 factory hours to produce a car. This produces a SC3 cost for the Factory land of $2. This figure is added to the other figures gained from the database,	
SC3 assessed against inputs	SC3	The diversity and productivity of Nature are primarily affected by the removal of the productive potential of a terrestrial or aquatic area as well as resource extraction to serve as inputs to a commercial stream	The land cleared for mining is a violation of SC3 because of the removal of the productive potential of the land area	Do these inputs violate SC3?
Animate PS from the Ecosphere must be assessed against SC3 to check if their harvest has destroyed, or threatens to destroy, the productive capacity or diminish, or threaten to diminish the diversity of the area harvested from	SC3	Ecosphere derived animate PS can either be the harvest of nature (current income) or their harvest can have led to the consumption of ecological capital in relation to the diversity of an area or its productive potential	Has the harvest of wood consumed the ecological capital of an area?	Has the harvest of this animate, ecosphere derived PS consumed the ecological capital of its harvest area?
Assessing Animate PS from the Ecosphere is done by creating a PM with the PS as the output and the area as the input	SC3 rule	It is not the PS itself that may have consumed ecological capital, but its effect on the area it was harvested from. As the area is also a PS the relationship between the two is shown in a PM	5 cubic metres of trees were harvested from an area. These are the outputs of a 'Tree production PM. The input is the harvest area of land	What area did this animate ecosphere derived PS come from? Join in a PM.

The restoration of a species protected by national or international agreement requires that the exact species, in the exact number and age be provided	SC3	The protection of a species suggests that it is of importance or its is threatened. Both have an impact on diversity	The ecological cost of a tiger skin (a protected species) would be the cost of raising a cub to the same maturity as the tiger whose skin is being used	Is this species protected?
Volume as a unit of measure can only be used if the specific gravity of a PS is also entered	General rule	Volume can only be converted to weight - the default unit of measure of the system - through the specific gravity.		
The scale used as the relative measure of a PM is the primary commercial output PS of that PM.	General rule	Scale is a relative measure, specific to the PM. It describes the quantity relationship of PS's of that PM. However it helps the ease of use of the system if it is kept to the primary commercial output.	A PM may contain salt and phosphate as inputs and fertiliser as an output. In this case the Fertilizer would be deemed the scale.	What is the primary commercial output of this PM?
Capital investments (plant and equipment) are at present not subject to ecological cost.	General	Plant and equipment are finished goods. The responsibility for their ecological costs rests with their manufacturer.	The lorry used to deliver a companies goods has at present zero ecological cost	Is the physical substance part of the capital investment of the company?
The ecological cost of a PS is calculated as the mean price of the 5 cheapest restorative prices for that PS	General	At the same time taking the mean of the 5 best prices reduces the volatility of ecological costs	The restorative price for SC1 for boron on the database are: $45, $57, $200, $35, $79, $23 per tonne. Take the mean of the best 5. Therefore the ecological cost is: $47.80	What is the mean of the 5 lowest prices for this PS?
If a PS has less than 5 prices entered on the database, the mean of the number of entries is taken	General	Even with a smaller sample, a mean price provides greater price stability	If Peroxide only has two restorative prices entered for it: $50 and $60, the ecological cost would be the mean of these two, ie. $55	If there are less than 5 restorative prices, what is the mean of the number that there are?
Calculate restoration cost at the most gross level of a PS as possible	General rule	It adds unnecessary complexity if a physical substance is broken down to its constituent parts	SC1 for wood can be calculated at this gross level. SC1 for Araldite require discovering which constituent parts came from the lithosphere	At this level can system violation be assessed? If yes then calculate. If no then breakdown.

Key

SC1 = System Condition One
SC2 = System Condition Two
SC3 = System Condition Three
PS = Physical Substance
PM = Production Moment

Claims

1. A computer controlled process for the determination of the amount of ecological capital consumed in producing a product, said method, in respect of any one product, including:

(a) providing one or more first data bases of information including categories of information, each of which includes data on at least one product as follows:

data pertaining to determining the physical substances used in the manufacture of said one product;

data on said physical substances and their properties (said properties including a chemical analysis) used in the manufacture of said one product;

data on all physical substances discharged in the manufacture of each product, wherein:

said substances include energy expressed as the physical substances taken to generate the energy;

data pertaining to the plurality of physical substances (including energy) used in the distribution of said product; and wherein

each said first data base is stored in memory means in an electronic medium;

(b) providing an algorithm to perform the following operations, said algorithm including three system conditions:

(i) that substances from the earth's crust must not systematically increase in the ecosphere ("condition one");

(ii) that substances produced by society must not systematically increase in the ecosphere ("condition two"); and

(iii) that the physical basis for the productivity and diversity of nature must not be systematically diminished ("condition three"); and

(c) providing appropriate programming instructions, in accordance with the algorithm, for the computer to carry out the steps of:

(i) in respect of said product, successively assessing each physical substance used in the manufacture of said input product against each system condition one and three;

(ii) in respect of said product, successively assessing each output physical substance used in the manufacture of said product against system condition two;

(iii) in respect of said product, successively assessing each physical substance used in the distribution of said product against the system conditions one, two and three, in the same manner as above; wherein

the sum of the successive assessments results in a quantitative value for the ecological capital consumed in respect of the production of said one product; whereby said instructions and algorithm are operated in a processing means connected to the or each memory means and

(d) said value (for the ecological capital) is provided through one or more media outlets.

2. A computer controlled process for the determination of the ecological cost of restoration of the environment in respect of each product, said steps being:

evaluating the amount of ecological capital consumed, as defined above, and including the additional steps of:

under step (a) incorporating into a second data base data pertaining to the restoration cost of each said input physical substance; and

under step (c) adding the following two steps:

(iv) for each of the above assessments in which the system condition is not met, determining the quantity of each input physical substance present in said product and then successively calculating a cost for the restoration of that physical substance within the ecosystem, to the point where the system condition in question is then met;

(v) for said input product ascertaining the quantity of the product required and summing up the restoration cost for each substance for which a restoration cost is calculated, to produce a cost value for the ecological cost of the said product; wherein

said second data base is accessible remotely by users of each said first data base.

3. A computer controlled process as claimed in claim 2, said process further including the step of providing the actual direct financial cost of manufacture of each said product at the same time as said ecological cost is provided through one or more outlet media from said electronic medium.

4. A computer controlled process as claimed in any preceding claim wherein said algorithm includes calculation of the following equation:

$$E = N(SC1(Q*PI*\$R) + N*SC2(Q*P\ O\ *\$R) + SC3(Q*PI*\$R))$$

in which:

E = Ecological cost of product

SC = assessment against a system condition (either 0 or 1)

Q = the quantity of the input physical substance

PI = the input input substance

P O = the physical output substance

$R = restoration cost of actual examples (or medium of five)

N = number of physical substances, either inputs, outputs or distribution values for the product respectively.

5. A computer controlled process as claimed in any one of the preceding claims wherein the time taken in the manufacture of any one product is deemed to be zero.

6. A computer controlled process as claimed in any one of the preceding claims wherein system condition one is assessed on inputs into the manufacture of each said one product.

7. A computer controlled process as claimed in any one of claims 2 to 6 wherein a user of said process is remote from the second database storage site and accesses said second data base by remotely controlled electronic means.

8. A computer controlled process as claimed in claim 7 wherein said remotely controlled electronic means is the internet.

9. A computer controlled process as claimed in any one of the preceding claims wherein each first data base contains data pertaining to the manufacture of more than one product.

10. A computer controlled process as claimed in any one of the preceding claims wherein data pertaining to the manufacture of any one product is contained in a plurality of first data bases.

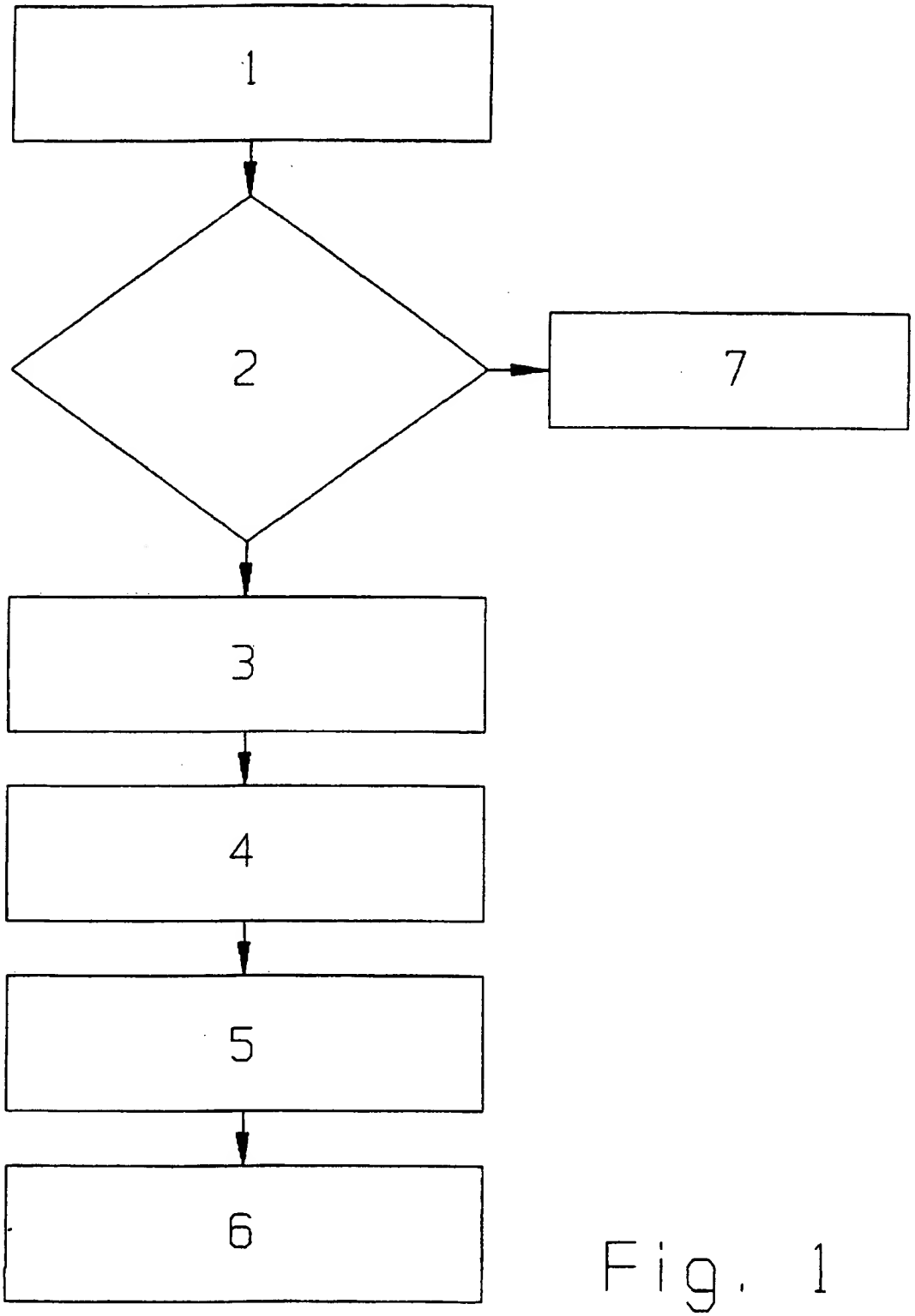

Fig. 1

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/NZ 97/00115

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: G06F 17/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : G06F 17/60

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT, PLUS, INSPEC, INTERNET.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5546564 A (HORIE) 13 August 1996 Whole document	1-10
A	US 5412756 A (BAUMAN et al) 2 May 1995 Whole document	1-10
A	US 5293309 A (SAKAI et al) 8 March 1994 Whole document	1-10

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 December 1997	23 DEC 1997

Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	R STOPFORD Telephone No.: (02) 6283 2177

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/NZ 97/00115

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"APPLICATION OF EXERGY FOR THE CALCULATION OF ECOLOGICAL COST". BULLETIN OF THE POLISH ACADEMY OF SCIENCES : TECHNICAL SCIENCES. V34. n 7-8. 1986. PP. 475-480. JAN SZARGUT. Whole document	1-10
A	"A MULTI-ENVIRONMENTAL COST EVALUATOR FOR PARALLEL DATABASE SYSTEMS. DATABASE SYSTEMS FOR ADVANCED APPLICATIONS '91. PROCEEDINGS OF THE SECOND INTERNATIONAL SYMPOSIUM, PP. 126-135. PUBLISHED : SINGAPORE 1992. V111 + 548 PP. FREDERIC ANDRES, MICHFU COUPRIE, YAWN VIEMONT. Whole document	1-10
T,A	"1ST TO CALCULATE ECOLOGICAL COST" HTTP : // WWW. TRUCOST. CO. NZ/ (OPI 12 DECEMBER 1997) Whole document	1-10
T,A	"ENVIRONMENTAL COST ESTIMATING SOFTWARE REPORT" HTTP :// WWW. DONLEYTECH. COM/ (OPI 12 DECEMBER 1997) Whole document	1-10

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/NZ 97/00115

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
US	5546564	JP	7091083
US	5412756	JP	6301546
US	5293309	JP	63087289

END OF ANNEX